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Kato

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(54) **IMAGE FORMING APPARATUS**

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G03G 15/08	(2006.01)
G03G 15/01	(2006.01)
G03G 21/16	(2006.01)

(52) **U.S. Cl.**

CPC ***G03G 15/0813*** (2013.01); ***G03G 15/0189*** (2013.01); ***G03G 21/1671*** (2013.01); ***G03G 21/1676*** (2013.01)

(58) **Field of Classification Search**

CPC G03G 15/0813; G03G 21/1671; G03G 21/1676
USPC 399/119
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

6,157,797	A	12/2000	Saito et al.
7,656,496	B2	2/2010	Kim et al.
8,107,855	B2	1/2012	Nishimura et al.
8,467,703	B2	6/2013	Nishimura et al.
8,744,308	B2	6/2014	Nishimura et al.

(Continued)

FOREIGN PATENT DOCUMENTS

JP	04172476	A *	6/1992
JP	11-295952	A	10/1999

(Continued)

OTHER PUBLICATIONS

Jun. 9, 2015—(JP) Notice of Reasons for Rejection—App 2011-188487.

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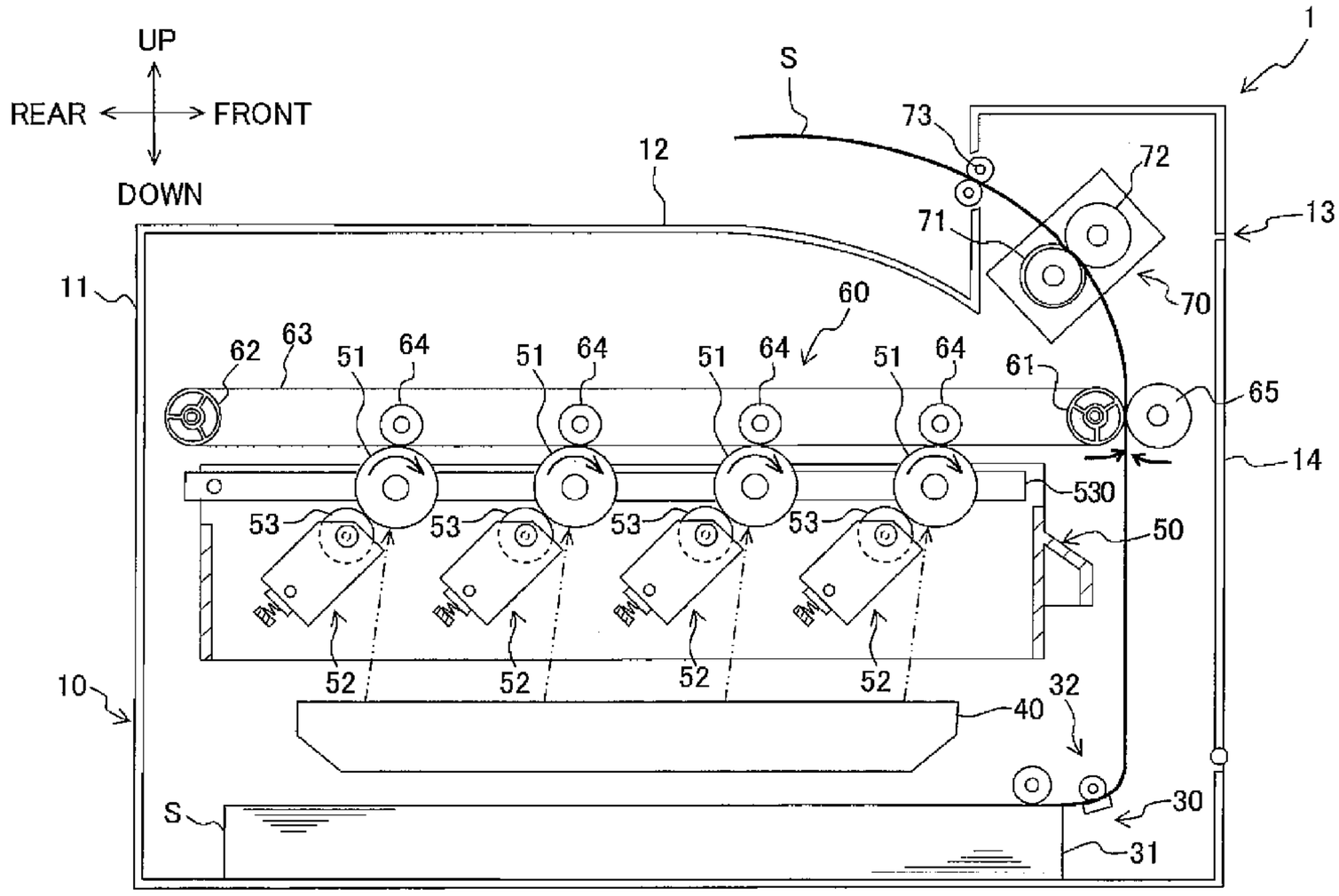
(57) **ABSTRACT**

An image forming apparatus includes: a photosensitive body on which an electrostatic latent image is formed; a developing cartridge arranged below the photosensitive body and having a developing roller configured to supply a developing agent to the photosensitive body and to be rotatable about an rotation shaft of the developing roller; a support body configured to removably support the developing cartridge; and a pressing member configured to press the rotation shaft of the developing roller so as to press the developing roller against the photosensitive body.

11 Claims, 8 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

9,075,343	B2	7/2015	Nishimura et al.	
2004/0174426	A1	9/2004	Nomura et al.	
2005/0243262	A1	11/2005	Kim et al.	
2006/0067734	A1*	3/2006	Igarashi et al.	399/119
2009/0245859	A1*	10/2009	Okabe	399/117
2009/0317133	A1	12/2009	Nishimura et al.	
2009/0324283	A1*	12/2009	Mushika et al.	399/119
2010/0135694	A1	6/2010	Hashimoto et al.	
2010/0209140	A1*	8/2010	Kamimura et al.	399/111
2010/0239329	A1*	9/2010	Kitani et al.	399/285
2012/0107015	A1	5/2012	Nishimura et al.	
2012/0328329	A1	12/2012	Sato et al.	
2013/0266342	A1	10/2013	Nishimura et al.	
2014/0270850	A1	9/2014	Nishimura et al.	

FOREIGN PATENT DOCUMENTS

JP	2003-195648	A	7/2003
JP	2003-205647	A	7/2003
JP	2003-207965	A	7/2003
JP	2004-109455	A	4/2004
JP	2005-316375	A	11/2005
JP	2009-181002	A	8/2009
JP	2010-008511	A	1/2010
JP	2010-128342	A	6/2010
JP	2010-224085	A	10/2010
JP	2013-007945	A	1/2013

* cited by examiner

Fig. 1

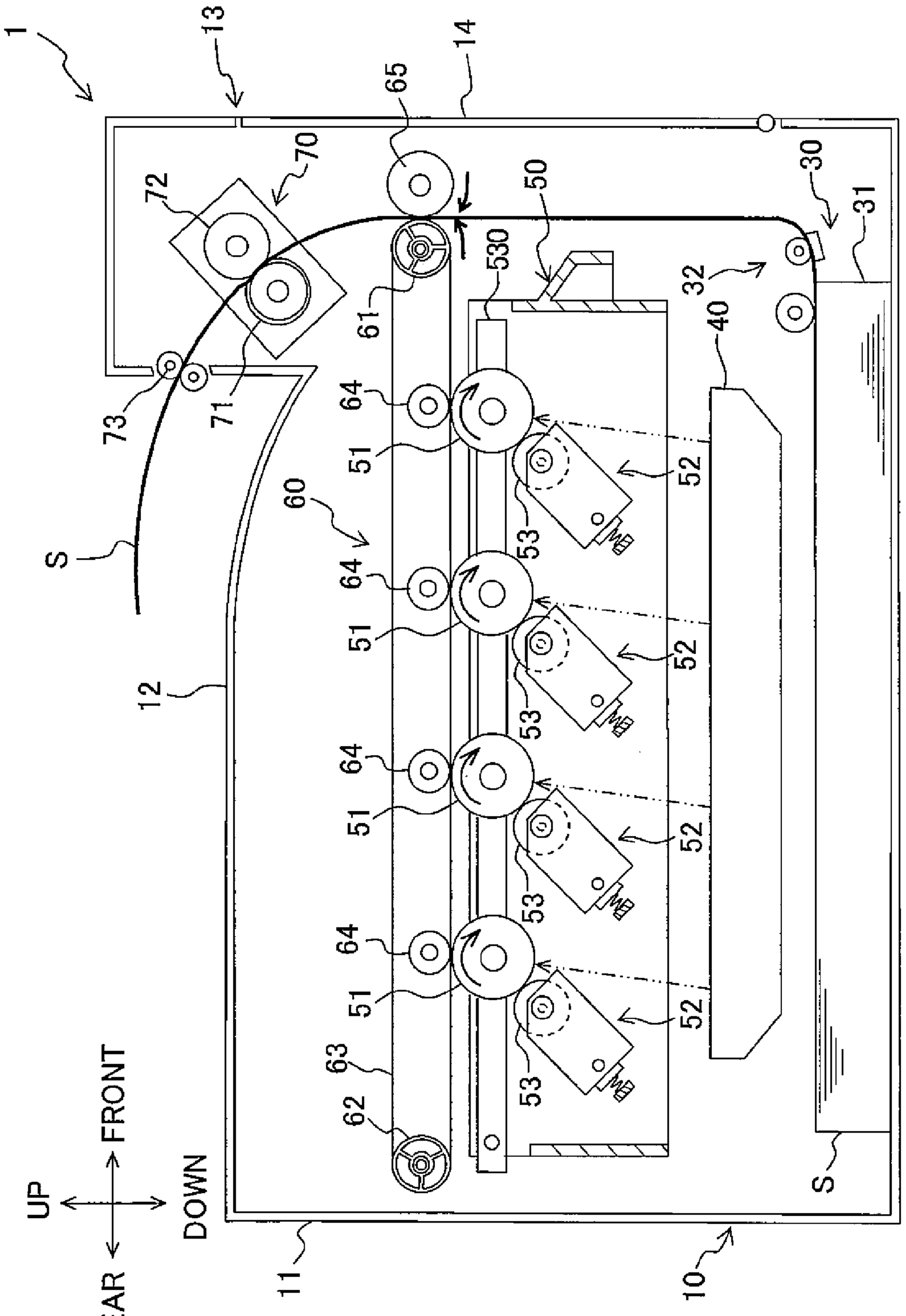
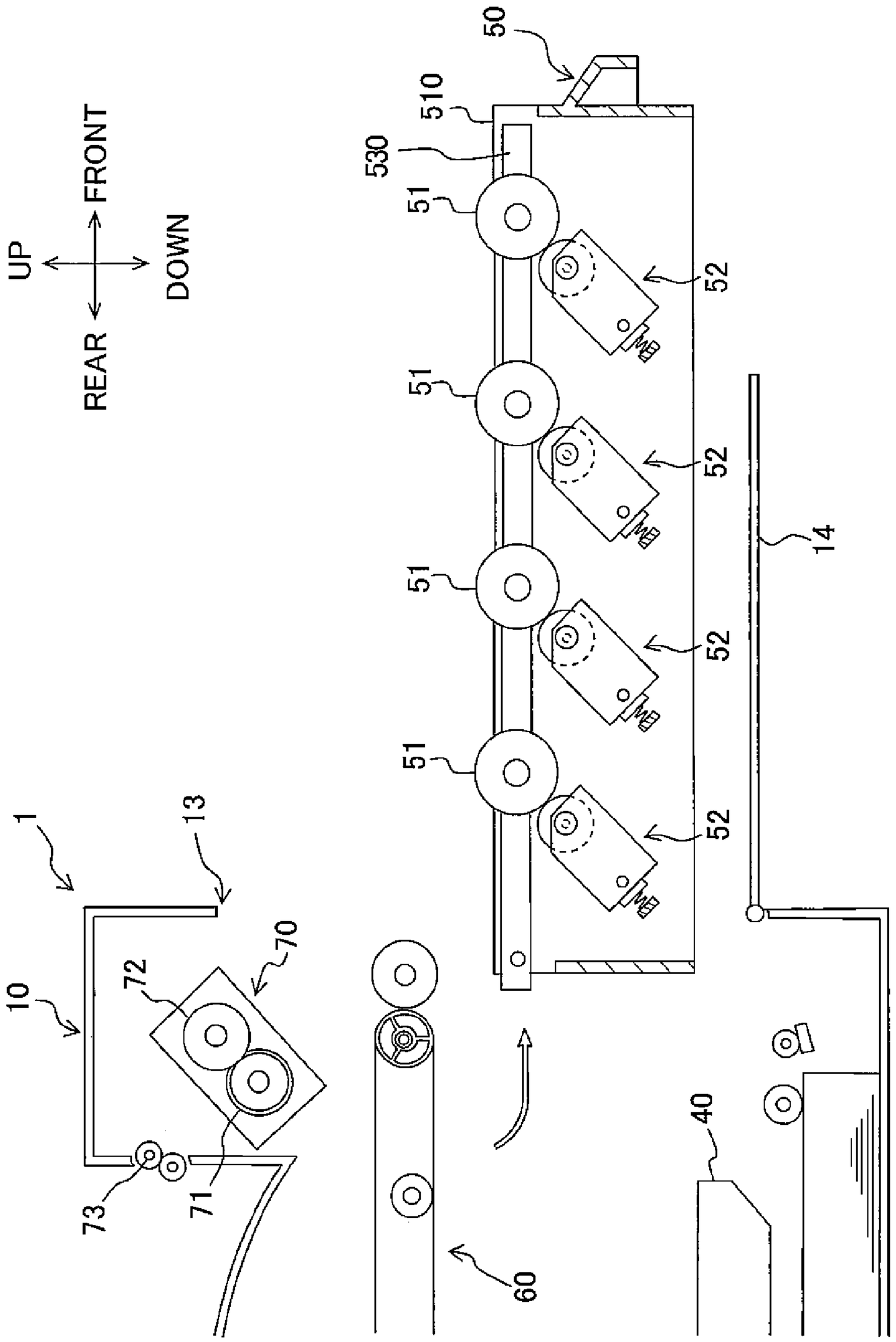

1
13
14
65
70
72
50
30
31
530
61
32
40
64
51
52
53
60
63
62
12
S
73
71
11
10
UP
DOWN
FRONT
REAR

Fig. 2



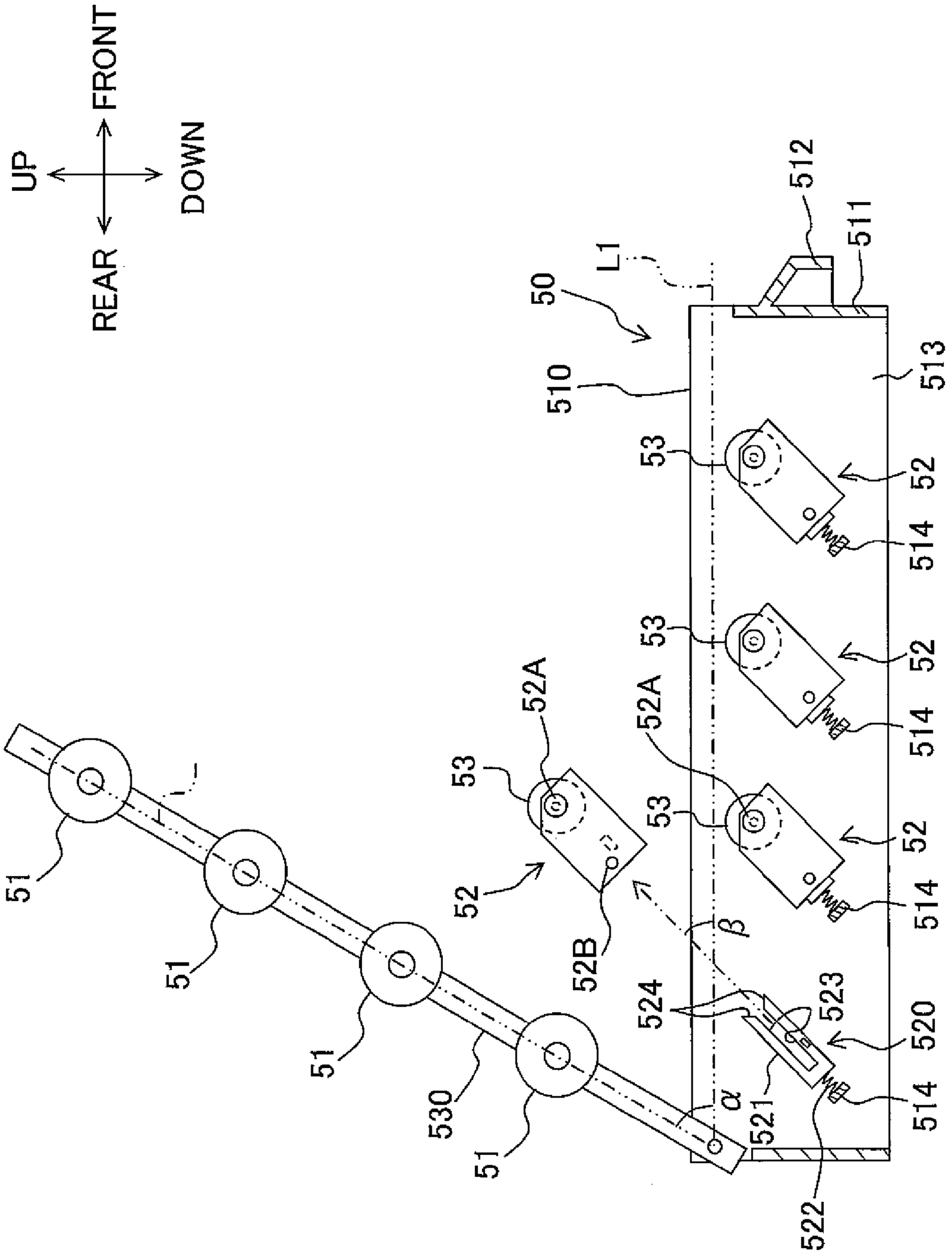

FRONT
UP
DOWN
REAR
51
L1
50
510
511
512
513
53
52
514
52A
52B
β
α
524
523
520
521
522
530

Fig. 3

Fig. 4A

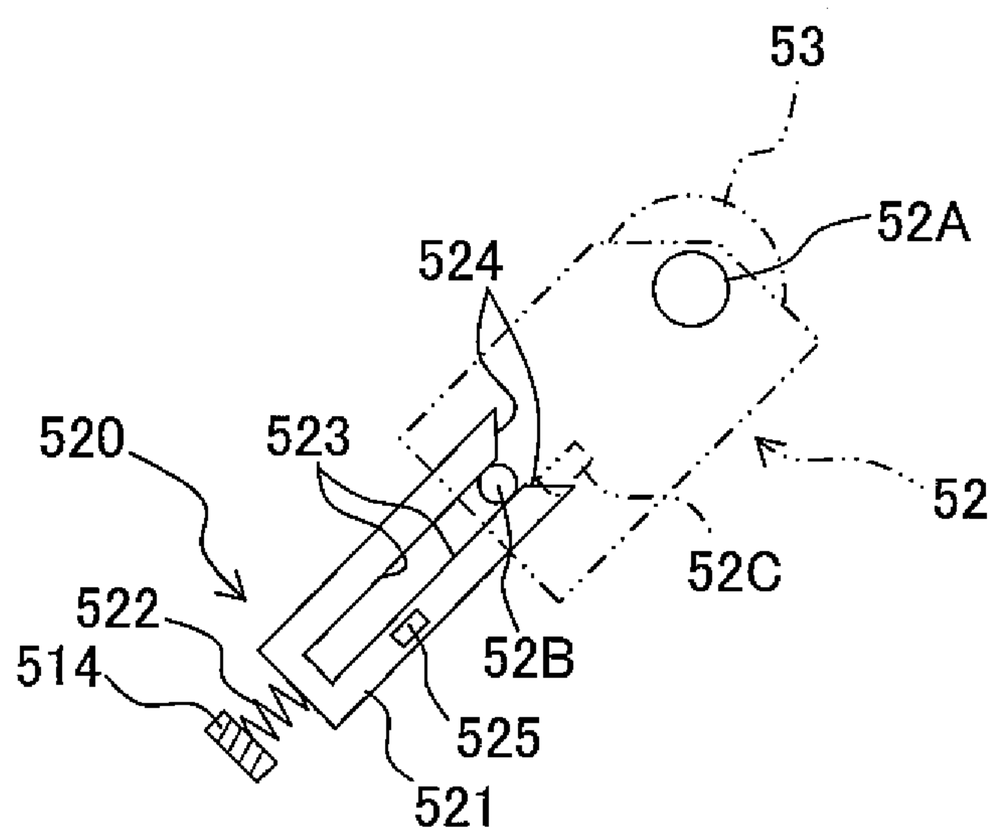


Fig. 4B

Fig. 4C

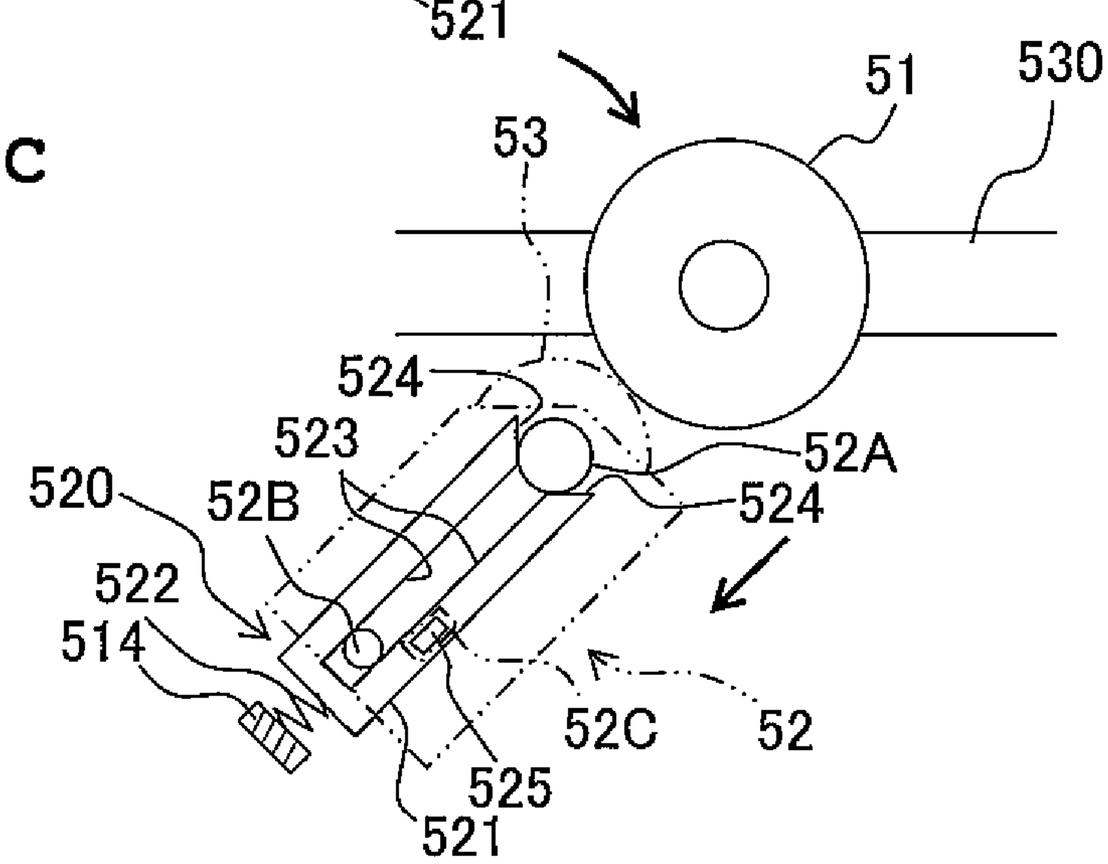


Fig. 5A

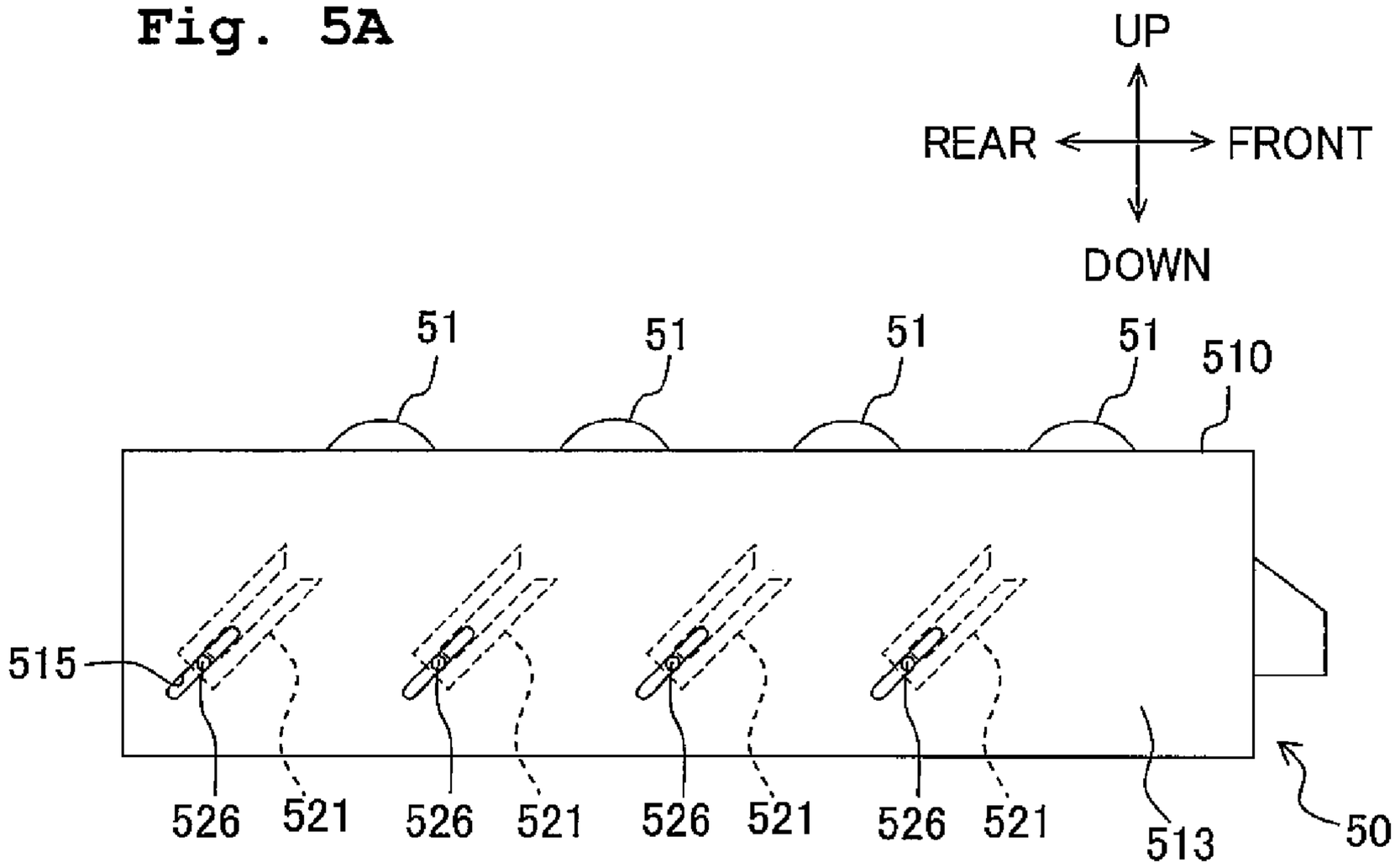


Fig. 5B

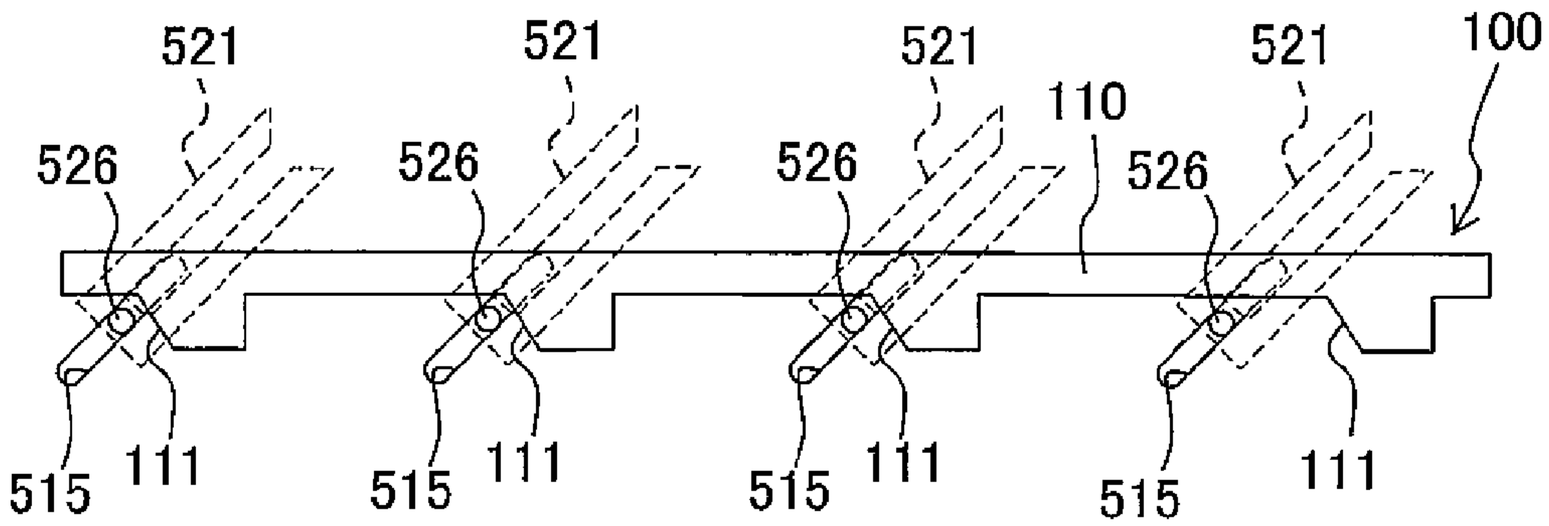


Fig. 5C

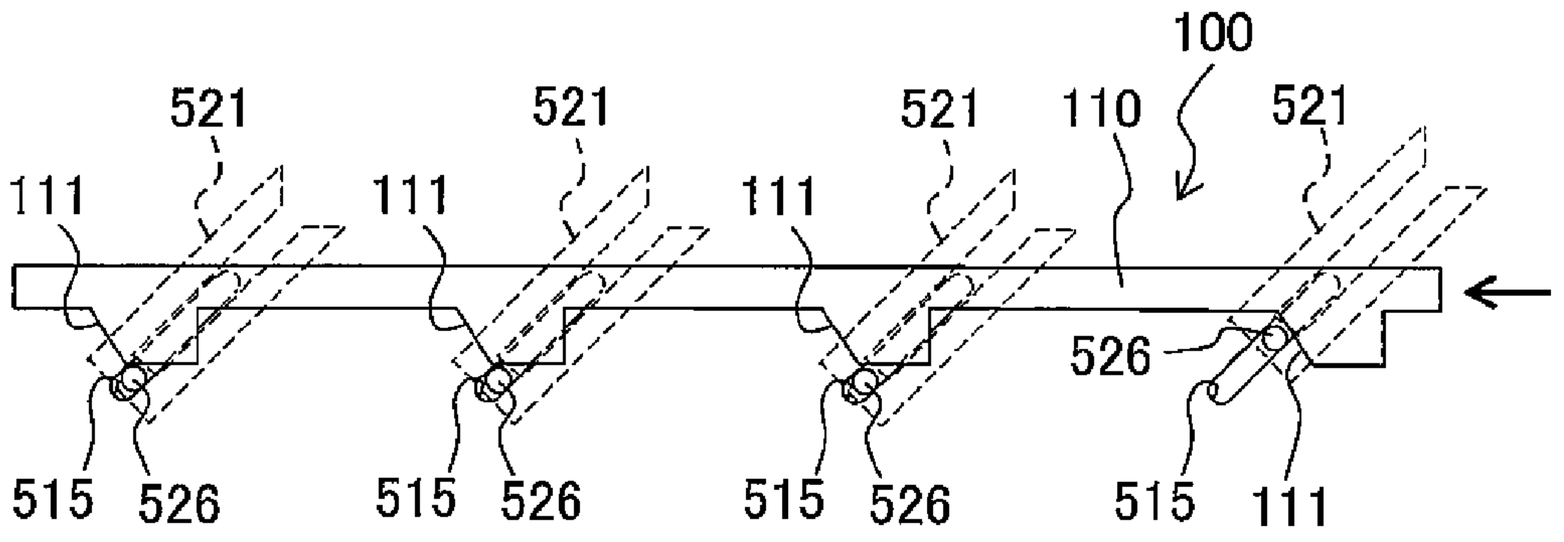


Fig. 6A

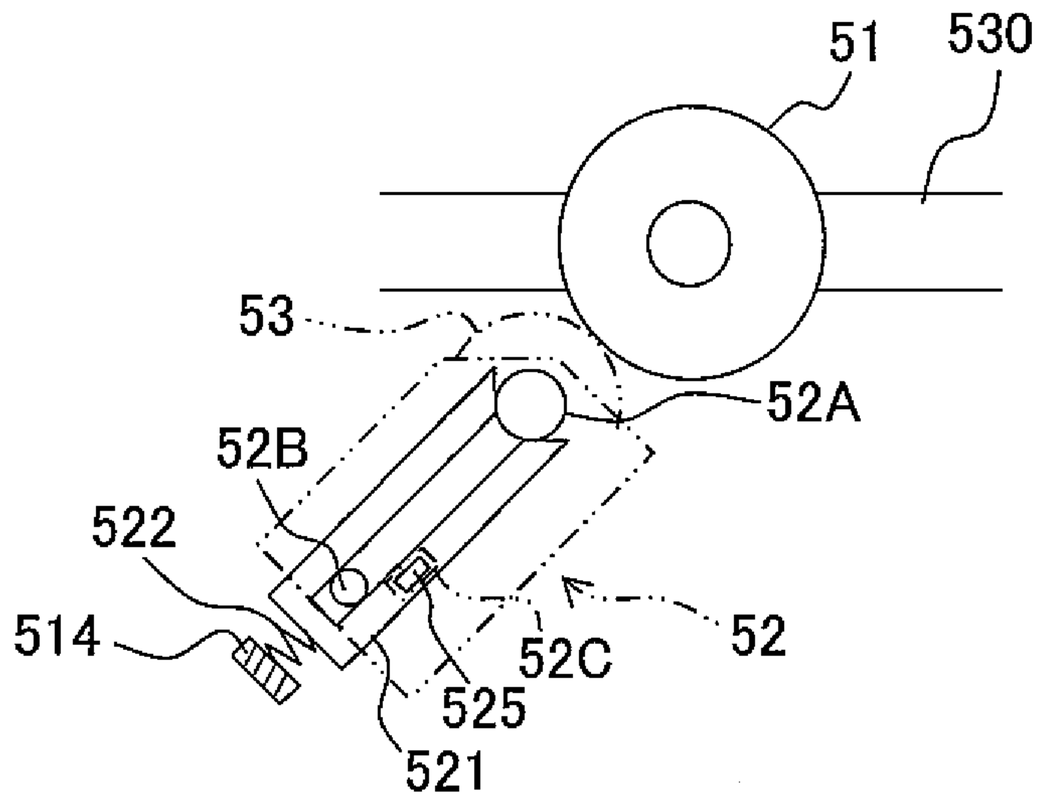

51
530
53
52A
52B
522
514
52C
52
525
521

Fig. 6B

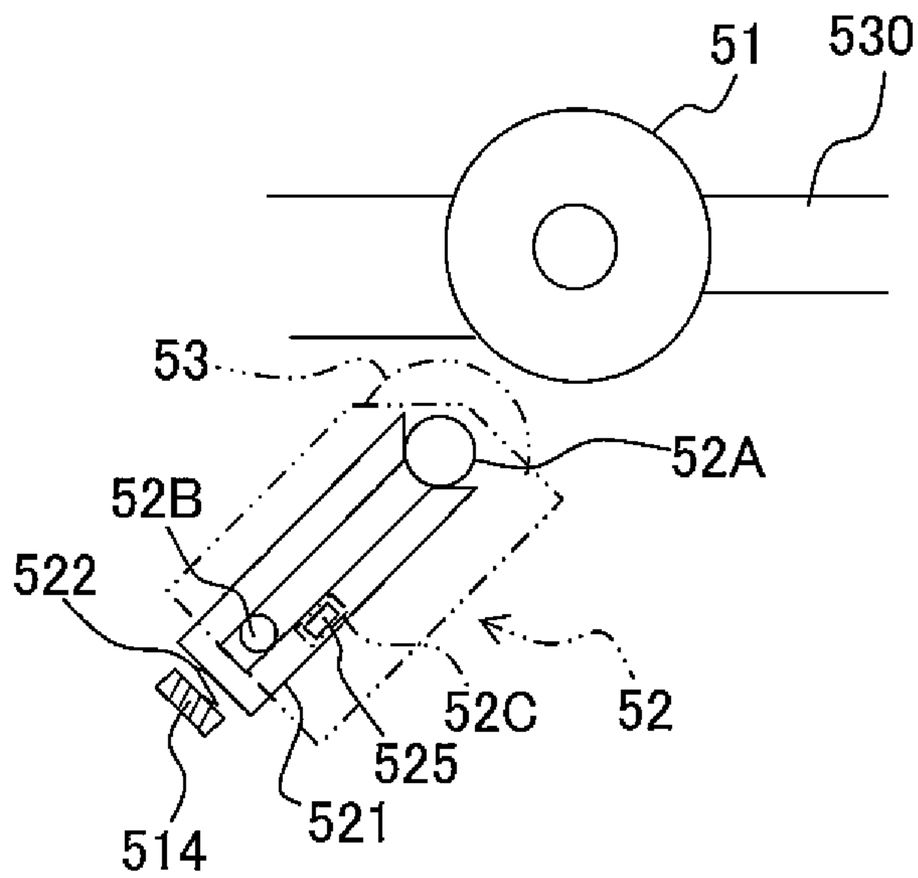

51
530
53
52A
52B
522
52C
52
525
514
521

Fig. 7

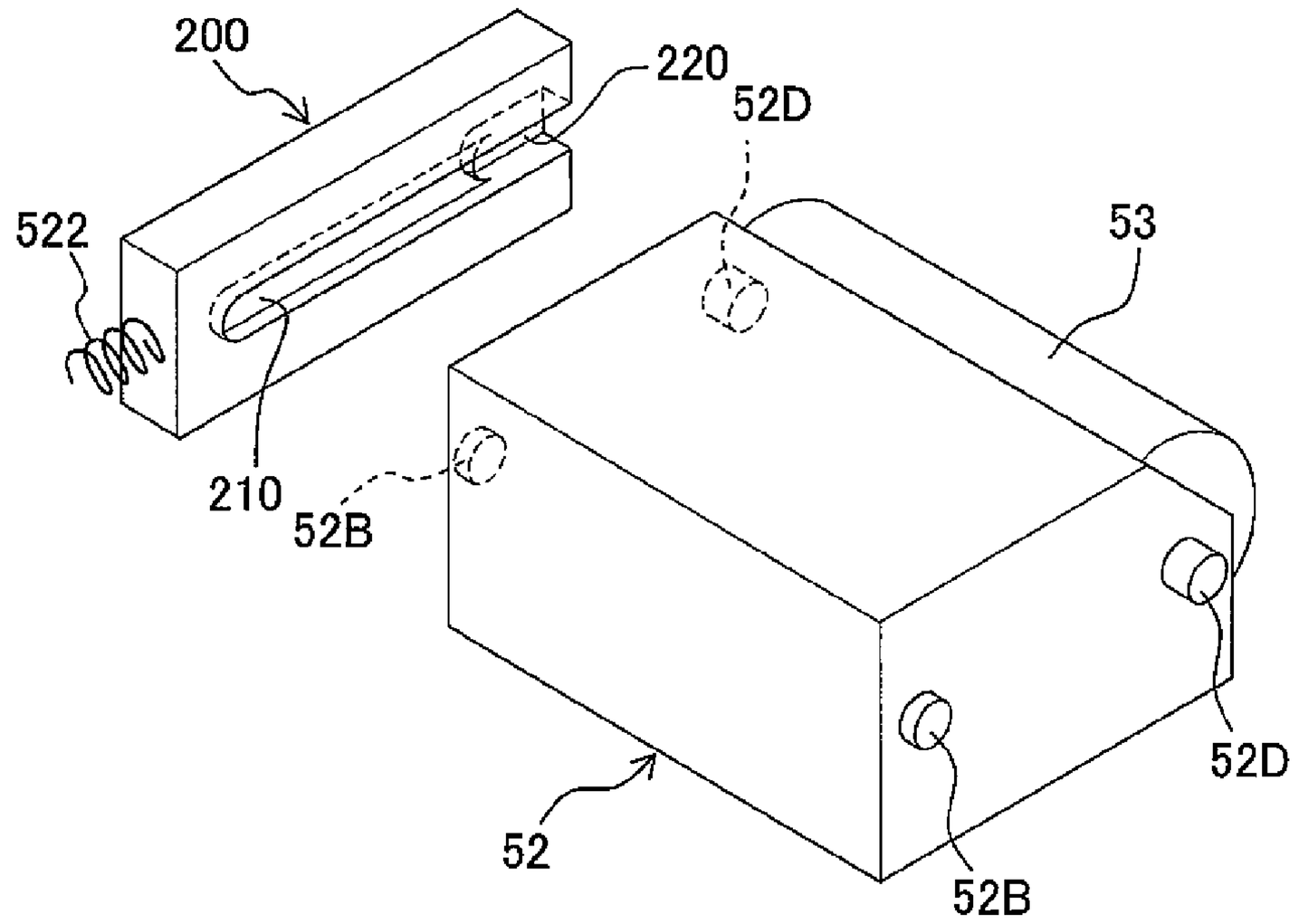

200
220
52D
522
53
210
52B
52D
52
52B

Fig. 8

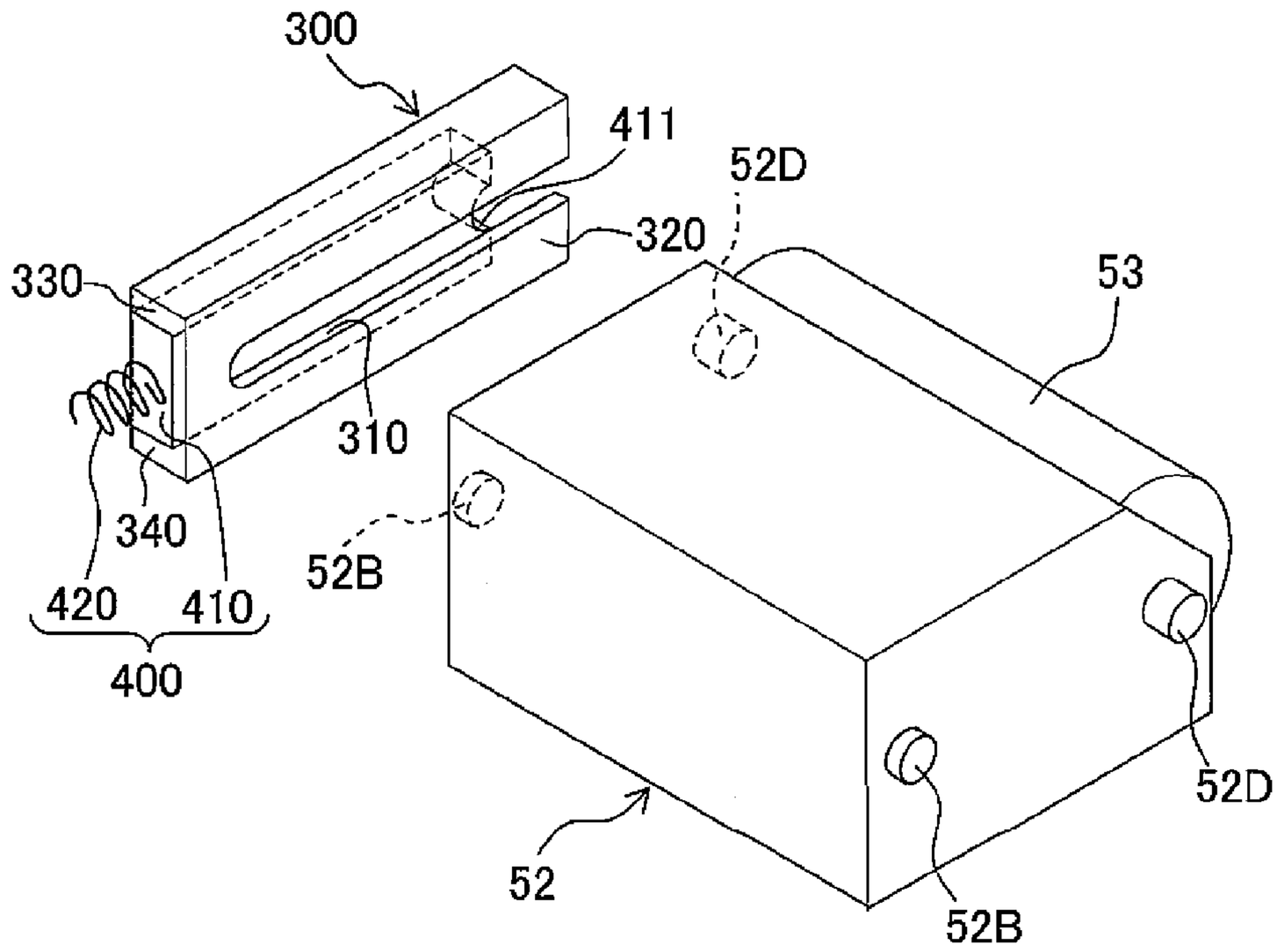

300
411
52D
320
330
53
310
340
52B
420
410
400
52D
52
52B

Fig. 9

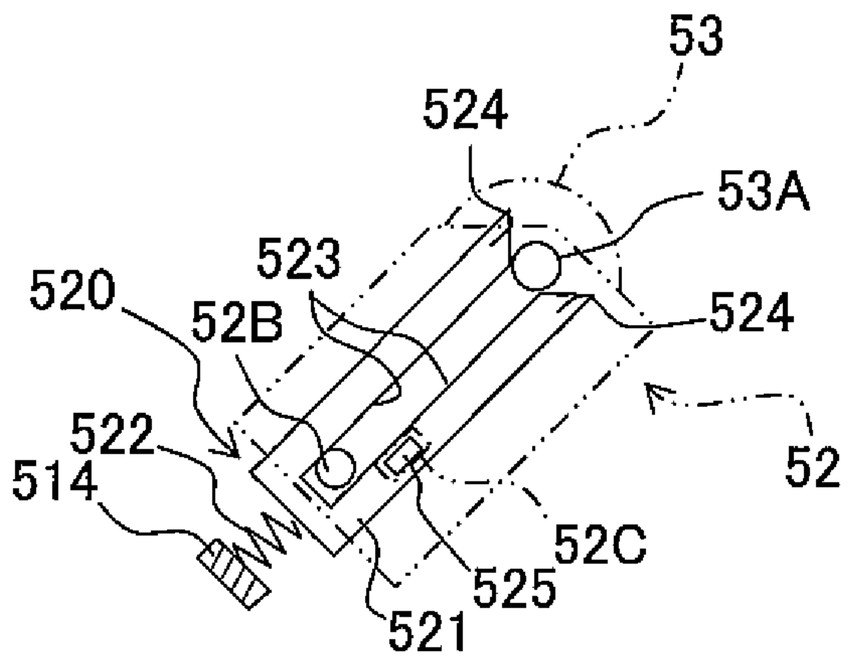


IMAGE FORMING APPARATUS

CROSS REFERENCE TO RELATED APPLICATION

The present application claims priority from Japanese Patent Application No. 2011-188487 filed on Aug. 31, 2011 the disclosure of which is incorporated herein by reference in its entirety.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to an image forming apparatus having a developing roller pressed toward or against a photosensitive body.

2. Description of the Related Art

Conventionally, there is known an image forming apparatus including a photosensitive drum and a developing cartridge arranged over or above the photosensitive drum and having a developing roller for supplying a toner to the photosensitive drum. In this technique, a boss is provided on a housing of the developing cartridge arranged above the developing roller; and when the boss is pressed downwardly with a pressing member, the developing roller arranged below the developing cartridge is pressed against the photosensitive drum.

In this technique, the developing roller is arranged to be oriented downwardly, and thus not only the pressing force of the pressing member but also the self weight of the developing cartridge contribute to bring the developing roller into pressurized contact with the photosensitive drum, thereby making it possible to stably press the developing roller against the photosensitive drum. Note that the term "the developing roller is arranged to be oriented downwardly (upwardly)" means that the developing roller is arranged or located such that a portion, of the developing roller, which faces the photosensitive body such as the photosensitive drum extends downwardly (upwardly).

SUMMARY OF THE INVENTION

However, in a case that the developing cartridge as described above is arranged below the photosensitive drum in a state that the developing roller extends upwardly, the boss which is located away from and at a location lower than the developing roller needs to be urged upwardly. Accordingly, there is a fear that the pressing force pressing the developing roller against the photosensitive drum might lean or offset in the axis direction of each of the developing roller and the photosensitive drum.

In view of the above situation, an object of the present teaching is to provide an image forming apparatus including a developing cartridge having a developing roller arranged to be oriented upwardly, the image forming apparatus being capable of pressing the developing roller against a photosensitive body such as a photosensitive drum with respect to the axis direction of the developing roller, in a well-balanced manner.

According to an aspect of the present teaching, there is provided an image forming apparatus configured to form an image on a sheet-shaped medium, including:

a photosensitive body on which an electrostatic latent image is formed;

a developing cartridge arranged below the photosensitive body and having a developing roller configured to supply a developing agent to the photosensitive body and to be rotatable about a rotation shaft of the developing roller;

a support body configured to removably support the developing cartridge; and

a pressing member configured to press the rotation shaft of the developing roller so as to press the developing roller against the photosensitive body.

Here, the term "arranged below the photosensitive body" means that the rotation shaft of the developing roller is arranged at a position below the rotation shaft of the photosensitive body. Further, the term "rotation shaft of the developing roller" encompasses also an axis portion which is provided to be coaxial with the rotation shaft of the developing roller.

According to this construction, the rotation shaft of the developing roller extending upwardly or the axis portion being coaxial with the rotation shaft is pressed by the pressing member. Thus, it is possible to press the developing roller against the photosensitive body in the axis direction and in a well-balanced manner as compared with the construction in which a portion, of the developing roller, that is located below the rotation shaft of the developing roller is pressed.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an explanatory view showing a color printer as an example of image forming apparatus.

FIG. **2** is an explanatory view showing a state that a drawer is pulled out from an apparatus body of the printer.

FIG. **3** is an explanatory view showing a state that a photosensitive body support member is pivoted upwardly.

FIGS. **4**A to **4**C are explanatory views showing movement of respective parts or components until the developing cartridge is installed in the drawer.

FIGS. **5**A to **5**C are explanatory views showing a relationship between a guide member and a separating mechanism.

FIG. **6**A is a an explanatory view showing a state that a developing roller is brought into contact with a photosensitive drum, and FIG. **6**B is an explanatory view showing a state that the developing roller is separated away from the photosensitive drum.

FIG. **7** is a perspective view of a modification of the guide member.

FIG. **8** is a perspective view of an aspect in which the guide member and an axial support portion are formed separately.

FIG. **9** shows an explanatory view corresponding to FIG. **4**B in which the rotation shaft of the developing roller is pressed directly by the pressing member.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Next, a detailed explanation will be made about a color printer as an example of the image forming apparatus according to an embodiment of the present teaching, with reference to the drawings appropriately. Note that in the following explanation, the directions are defined based on directions seen from a user when using the color printer. Namely, in FIG. **1**, the right side on the sheet surface is defined as "front"; the left side on the sheet surface is defined as "rear"; in a direction perpendicular to the sheet surface, the front side on the sheet surface is defined as "left" and the far side on the sheet surface is defined as "right". Further, in FIG. **1**, the up/down direction in the sheet surface is defined as "up" and "down", respectively.

As shown in FIG. **1**, a color printer **1** includes a paper feeding unit **30**, a scanner unit **40**, a drawer **50**, a transfer unit **60** and a fixing unit **70** in an apparatus body **10** of the color printer **1**.

The apparatus body **10** has a paper discharge tray **12** configured to accommodate paper sheets S, at an upper portion of the apparatus body **10**. Further, an opening **13** through which the drawer **50** is pulled out of or removed from the apparatus body **10**, is formed in a front wall portion of the apparatus body **10**; and a front cover **14** for opening/closing the opening **13** is pivotably provided on the apparatus body **10**.

The paper feeding unit **30** is arranged in the apparatus body **10** at the lower portion of the apparatus body **10**, and includes a paper feeding tray **31** configured to accommodate the paper sheets S and a paper sheet supply mechanism **32** configured to transport the paper sheets S from the paper feeding tray **31** to a transfer position. Here, the transfer position is located between an intermediate transfer belt **63** and a secondary transfer roller **65**. The paper sheets S in the paper feeding tray **31** are separated one by one by the paper sheet supply mechanism **32** and are each transported to the transfer position.

The scanner unit **40** is arranged above or over the paper feeding unit **30** and includes an un-illustrated laser beam emitting section, an un-illustrated polygon mirror, an un-illustrated lens, an un-illustrated reflecting mirror, etc. Further, in the scanner unit **40**, a laser beam passes or travels in a route indicated by two-dot chain line in **1** and the laser beam is irradiated on a surface of a photosensitive drum **51**, as an example of the photosensitive body, such that the laser beam is subjected to scanning at high speed.

The drawer **50** is arranged at a position below or under the intermediate transfer belt **63**, to be located between the intermediate transfer belt **63** and the scanner unit **40**; and the drawer **50** is supported to be movable with respect to the apparatus body **10** in a substantially front/rear direction, and is capable of being pulled out frontward from the opening **13** of the apparatus body **10**, as shown in FIG. **2**. Specifically, the drawer **50** is supported by un-illustrated rails. The rails extend in the front/rear direction and of which rear end portion extends rearward and obliquely upward so that the drawer **50** is separated away from the intermediate transfer belt **63** when the drawer **50** is pulled out from the apparatus body **10**.

In the drawer **50**, four pieces of the photosensitive drum **51**, four un-illustrated publicly known chargers and four developing cartridges **52** are arranged; and each of the developing cartridges **52** includes a developing roller **53**, an un-illustrated publicly known supply roller, an un-illustrated publicly known layer-thickness regulating blade, an un-illustrated publicly known tonner accommodating chamber, etc. Each of the developing cartridges **52** is arranged at a position at which the developing roller **53** extends upward and the rotation shaft of the developing roller **53** is located below or under the rotation shaft of one of the photosensitive drums **51**. The constructions of the drawer **50** and the developing cartridges **52** will be described in detail later on.

The transfer unit **60** is arranged above the drawer **50**, and includes a driving roller **61**, a driven roller **62**, the intermediate transfer belt **63** which is an endless belt stretched between the driving roller **61** and the driven roller **62**, four primary transfer rollers **64** arranged to face the photosensitive drums **51** respectively via the intermediate transfer belt **63**, and a secondary transfer belt **65** arranged to face the driving roller **61** via the intermediate transfer belt **63**.

In the drawer **50** and the transfer unit **60** described above, at first, the surface of each of the photosensitive drums **51** is uniformly charged by the charger, and then is exposed by the scanner unit **40**. With this, an electrostatic latent image based on an image data is formed on each of the photosensitive drums **51**. Further, the tonner in the tonner accommodating chamber is held on the surface of the developing roller **53** via the supply roller.

The tonner held on the surface of the developing roller **53** is supplied from the developing roller **53** to the electrostatic latent image on each of the photosensitive drums **51**. With this, the electrostatic latent image is visualized and an image of the tonner (tonner image) is formed and held on each of the photosensitive drums **51**. Tonner images of respective colors formed on the photosensitive drums **51**, respectively, are successively overlaid and transferred on the intermediate transfer belt **63**. Further, when paper sheet S transported from the paper feeding unit **30** is made to pass the transfer position between the intermediate transfer belt **63** and the secondary transfer roller **65**, the tonner images formed on the intermediate transfer belt **63** are transferred onto the paper sheet S.

The fixing device **70** is arranged to be located in front of and above the transfer unit **60**, and includes a heating roller **71**, a pressure roller **72** arranged to face the heating roller **71** and configured to press the heating roller **71**, and a discharge roller **73** configured to discharge the paper sheet S on which the tonner images are fixed to the outside of the apparatus body **10**, in the fixing device **70**, the paper sheet S on which the toner images are fixed is made to pass between the heating roller **71** and the pressure roller **72** to thereby thermally fix the toner images on the paper sheet S, and the paper sheet S is discharged by the discharge roller **73** to the outside of the apparatus body **10** and is placed on the paper discharge tray **12**.

<Construction of Drawer **50** and Developing Cartridge **52**>

As shown in FIG. **3**, the drawer **50** includes a support body **510** configured to removably (detachably) support the developing cartridges **52**, four pressure members **520** configured to press the developing rollers **53** against the photosensitive drums **51**, respectively, and a photosensitive body-support member **530** configured to rotatably support the four photosensitive drums **51**.

The support body **510** is formed to have a rectangular box shape which is hollow and is open in the upper and lower portions thereof, and has a front wall **511** and a handle **512** which is provided on the front wall **511** and which is grasped by a user. Further, four projections **514** are provided on each of left and right side walls **513** of the support body **510** to project inwardly in the left/right direction, namely project toward the inside of the support body **510**, so that the projections **514** support the respective pressing members **520**.

The pressing members **520** are each configured to press axis portions **52**A which are coaxial with the rotation shaft of the developing roller **53** upwardly (specifically, obliquely upwards and frontwards) to thereby press the developing rollers **53** against the photosensitive drums **51**, respectively. Here, the axis portions **52**A are formed to have a columnar shape projecting, from the left and right side walls of the developing cartridge **52**, outwardly in the left/right direction.

With this, the axis portions **52**A which are coaxial with the rotation shaft of each of the developing rollers **53** which are oriented upwardly are pressed upwardly by one of the pressure members **520**, thereby making it possible to press each of the developing rollers **53** against one of the photosensitive drums **51** in the axial direction and in a well-balanced manner as compared with a construction in which a portion, of each of the developing cartridges, located below the rotation shaft of each of the developing rollers.

Specifically, each of the pressing members **520** includes a guide member **521** configured to guide one of the developing cartridges **52** to an install position, and a coil spring **522** as an

example of an urging member configured to urge the guide member **521** toward the photosensitive drum **51**. Here, the term "install position" means a position at which the developing roller **53** extends upwardly and is capable of making contact with the photosensitive drum **51** (position indicated in FIG. **3**).

The guide member **521** is formed to have a substantially U-shape. An inner surface of the guide member **521** defines a pair of guide surfaces **523** configured to incline frontward and obliquely upwardly. As shown in FIGS. **4**A and **4**B, bosses **52**B formed in each of the developing cartridges **52** are guided by the pair of guide surfaces **523**. Each of the developing cartridges **52** is removable with respect to the support body **510** via the guide member **512**. Here, a removing direction in which the developing cartridge **52** is removed from the guide member **521** (support body **510**) is inclined obliquely upward toward the downstream of the pull-out direction of the support member **510**.

With this, it is possible to perform the install/remove operation of the developing cartridge **52** easily as compared with a construction in which the developing cartridge is installed/removed in a vertical direction. Note that the bosses **52**B protrude or project outwardly in the left/right direction from the left and right side walls respectively at lower portion of each of the developing cartridges **52**, and the bosses **52**B are formed to have a columnar shape of which diameter is smaller than the diameter of the axis portions **52**A.

Further, a pair of end portions **524** located while sandwiching an opening of the U-shaped guide member **521** therebetween are formed to incline in a V-shaped manner with respect to the guide surfaces **523** toward the downstream of the install direction of the developing cartridge **52**. With this, the pair of end portions **524** function as an axial support portion configured to support the axis portions **52**A of the developing cartridge **52**, as shown in FIG. **4**B.

Furthermore, the guide member **521** is supported by an un-illustrated guide rib, etc. so that the guide member **521** is movable in the install/remove direction of the developing cartridge **52** (direction in which the photosensitive drum **51** and the developing roller **53** face each other). Moreover, the coil springs **522** are provided between the guide members **520** and the projections **514** of the support body **510**.

Accordingly, as shown in FIGS. **4**A and **4**B, the developing cartridge **52** is installed in the guide member **521** so that the developing roller **53** extends upwardly; and then as shown in FIG. **4**C, when the developing roller **53** is pressed downwardly with the photosensitive drum **51**, then the developing cartridge **52** and the guide member **521** are integrally moved rearward and obliquely downward, thereby compressing the coil spring **522**. Then, the developing cartridge **52** is urged by the compressed coil spring **522** toward the photosensitive drum **51** via the guide member **521**, thereby pressing the developing roller **53** against the photosensitive drum **51**.

Further, a support body-side electrode **525**, which makes contact with a cartridge-side electrode **52**C provided on an outer surface of the developing cartridge **52**, is provided on an inner surface of the guide member **521**. By providing the support body-side electrode **525** on the guide member **521** configured to move together with the developing cartridge **52**, even when for example the developing cartridge **52** and the guide member **521** are vibrated following the wobbling of the surface of the photosensitive drum **51** during printing, it is possible to prevent the respective electrodes **52**C, **525** from being brought into contact slidably with each other, thereby preventing the respective electrodes **52**C, **525** from being worn.

Note that the support member-side electrode **525** is connected to an un-illustrated control board provided on the apparatus body **10** via an un-illustrated harness, etc.

Further, as shown in FIG. **5**A, pins **526** projecting outwardly in the left/right direction are provided on surfaces (outer surfaces), of the guide member **521**, on the outer side in the left/right direction. The pins **526** project outwardly through elongated holes **515** which are formed on the left and right side walls **513** of the support body **510**. Note that the elongated holes **515** are formed to extend in the install/remove direction of the developing cartridges **52**.

The pins **526** projecting outwardly through the support body **510** are configured to be movable along the elongated holes **515** by a separating mechanism **100** as shown in FIG. **5**B. The separating mechanism **100** includes a separation cam **110** and an un-illustrated driving mechanism configured to move the separation cam **110** in the front/rear direction.

The separation cam **110** is an elongated translation cam extending in the front/rear direction (arrangement direction of the plurality of photosensitive drums **51**); and the separation cam **110** moves rearward to thereby press and move the pins **526** rearward and obliquely downward. Specifically, the separation cam **110** is supported on the left and right side walls of the apparatus body **10** so that the separation cam **110** is movable in the front/rear direction.

The separation cam **110** has four cam surfaces **111** which are inclined with respect to the front/rear direction; and the separation cam **110** is configured to press the respective pins **526** by the four cam surfaces **111**. With this, as shown in FIGS. **6**A and **6**B, the guide member **521** is separated away from each of the photosensitive drums **51** and the developing cartridge **52** is lowered by self-weight together with the guide member **521**, thereby separating the developing rollers **53** away from the photosensitive drums **51**, respectively.

Further, by appropriately separating the developing rollers **53** away from the photosensitive drums **51**, respectively, it is possible, for example, to switch between color and monochrome modes. Note that as the un-illustrated driving mechanism configured to move the separation cam **110** in the front/rear direction, it is possible to adopt an appropriate driving mechanism such as a mechanism constructed of a motor, a gear, etc.; a mechanism configured to move the separation cam **110** in the front/rear direction interlocking with opening/closing of the front cover **14**; and the like.

Furthermore, the drawer **50** is configured not to interfere with the separation cam **110** during the install/remove operation of the drawer **50**. Specifically, when the drawer **50** is installed, the drawer **50** is firstly moved rearward by the un-illustrated rails and then is moved rearward and the obliquely upward. Therefore, the pins **526**, each projecting outwardly through the drawer **50**, are made to pass firstly below portions of the separation cam **110** at which the cam surfaces **111** are formed respectively, and then are moved to positions at which the pins **526** face the cam surfaces **111** respectively.

As shown in FIG. **3**, the photosensitive body-support member **530** is supported on the support body **510** pivotably at rear upper portions of the left and right side walls **513**. With this, when the developing cartridge(s) **52** is/are installed/removed, the photosensitive drums **51** can be retracted or withdrawn only by pivoting the photosensitive body-support member **530**, thereby making it possible to easily perform the install/remove operation of the developing cartridge(s) **52** as compared with a construction wherein the photosensitive drums need to be removed from the support body every time the developing cartridge(s) is/are installed/removed.

Further, since the four photosensitive drums **51** are integrally supported by the photosensitive body-support member **530**, the four photosensitive drums **51** can be retracted as a whole from the respective cartridges **52**, and thus the install/remove operation for the developing cartridges **52** can be performed easily.

Furthermore, the photosensitive body-support member **530** is configured to be pivotable between a first posture (posture shown in FIG. **1**) in which the photosensitive drums **51** are brought into contact with the developing rollers **53** respectively and a second posture (posture shown in FIG. **3**) in which the photosensitive drums **51** are retracted maximally from the developing rollers **53** respectively. Namely, an unillustrated regulating portion, which is configured to regulate the pivot range of the photosensitive body-support member **530**, is provided on the support body **510**, and the photosensitive body-support member **530** is made pivotable between the first and second postures by the regulating portion.

Moreover, a rotation angle α defined between the first and second postures of the photosensitive body-support member **530** is set to be greater than an angle β defined by the removing direction of the developing cartridges **52** with respect to the photosensitive body-support member **530** when the photosensitive body-support member **530** assumes the first posture. In other words, the angle α defined by a straight line L**1** connecting the pivot axis of the photosensitive body-support member **530** assuming the first posture with the rotation axes of the photosensitive drums **51** with respect to a straight line L**2** connecting the pivot axis of the photosensitive body-support member **530** assuming the second posture with the rotation axes of the photosensitive drums **51** is set to be greater than the angle β defined by the removing direction of the developing cartridges **52** with respect to the straight line L**1**.

With this, it is possible to install and remove the developing cartridge(s) **52** without being interfered with respect to the photosensitive body-support member **530**.

Note that the present teaching is not limited to the embodiment as described above, and is applicable in various forms or aspects as exemplified below. In the following explanation, a part or component which is substantially same as that of the above-described embodiment will be assigned with a same reference numeral as that of the embodiment, and the explanation therefore will be omitted.

In the above embodiment, the axis portions **52**A of each of the developing cartridges **52** are supported with the pair of end portions **524** of one of the U-shaped guide members **521**. The present teaching, however, is not limited to this construction; and it is allowable that a U-shaped axial support groove **220** supports an axis portion **52**D of a developing cartridge **52**, as shown in FIG. **7**. Specifically, in this construction, the axis portion **52**D of the developing cartridge **52** is provided as axis portions **52**D projecting or protruding outwardly in the left/right direction to an extent greater than bosses **52**B, and the axis portions **52**D are formed to have a columnar shape of which diameter is substantially same as the diameter of the bosses **52**B.

A guide member **200** is formed to have a rectangular parallelepiped shape and is provided with a U-shaped guide groove **210** guiding the boss **52**B of the developing cartridge **52** and the U-shaped axial support groove **220** formed in the guide groove **210** on the opening side thereof. The groove bottom surface of the U-shaped axial support groove **220** is extended outwardly to some extent in the left/right direction than the groove bottom surface of the guide groove **210**. According to this construction, since the axis portion **52**D is accommodated inside the U-shaped axial support groove **220**, it is possible to obtain such an effect, in addition to the effect similarly to that obtained by the above-described embodiment, that the axis portion **52**D is prevented in ensured manner from inadvertently or erroneously falling or detaching from the axial support groove **220** when the guide member **220** is moved by the separating mechanism **110**.

In the above-described embodiment, the pressing member **520** is constructed of the guide member **521** and the coil spring **522**. Namely, the guide member **521** and the coil spring **522** are integrated to construct the pressing member **520**. The present teaching, however, is not limited to such a construction; and it is allowable that the guide member and the pressing member are formed as separate members. For example, as shown in FIG. **8**, it is allowable to form a pressing member **400** with a contact member **410** which is movable, in the install/remove direction of the developing cartridge **52**, with respect to a guide member **300** fixed to the support body **510** (not shown in FIG. **8**), and a coil spring **420** as an example of the urging member configured to urge the contact member **410** toward the photosensitive drum **51**.

The guide member **300** is formed to have a substantially U-shaped form in sectional view and includes a body **320** in which a U-shaped slit **310** guiding a boss **52**B of a developing cartridge **52** having a construction same as that shown in FIG. **7**, and an upper wall portion **330** and a lower wall portion **340**. The upper wall portion **330** and a lower wall portion **340** extend from upper and lower end portions, respectively of the body **320** outwardly in the left/right direction and are fixed to the support body **510** (not shown in FIG. **8**).

The contact member **410** is configured to be slidable in the guide member **300** having the substantially U-shaped form in sectional view; and the contact member **410** has, on an end portion thereof on a side opposite to the coil spring **420**, a semi-circular shaped axial support portion **411** configured to receive the axis portion **52**D of the developing cartridge **52**. As described above, also in a case that the axial support section **411** is formed as a separate body or member from the guide member **300**, it is possible to press the axis portion **52**D of the developing cartridge **52**.

Note that, however, in a case that the guide member **521** and the axial support portion (the pair of end portions **524**) are formed as an integrated body or member, it is possible to reduce the number of parts or components as compared with the case that the axial support portion and the guide member are formed as separate bodies.

In the above-described embodiment, the axis portions **52**A, which are coaxial with the rotation shaft of the developing roller **53**, are pressed by the pressing member **520**. However, the present teaching is not limited to such a configuration. It is not indispensable that the developing roller **53** includes the axis portions **52**A. For example, as shown in FIG. **9**, it is allowable to press the rotation shaft **53**A of the developing roller **53** with the pressing member **520**. As compared with the developing roller **53** as shown in FIG. **4**B, instead of pressing the axis portions **52**A configured to be coaxial with the rotation shaft **53**A of the developing roller **53**, the rotation shaft **53**A of the developing roller **53** is directly pressed by the pressing member **520**.

In the embodiment, the photosensitive body is exemplified by the photosensitive drum **51**. However, the present teaching is not limited to this, and it is allowable to use, as the photosensitive body, for example a belt-shaped photosensitive body.

In the embodiment, the support body configured to removably support the developing cartridge is exemplified by the support body **510** configured to be movable with respect to the apparatus body **10**. However, the present teaching is not

limited to this, and it is allowable that the support body is, for example, a frame constructing the apparatus body.

In the embodiment, the present teaching is applied to the color printer **1**. However, the present teaching is not limited to this, and it is allowable that the present teaching is applied to other image forming apparatuses, such as a monochrome printer, a copying machine, a multi-functional machines, etc. In the embodiment, the sheet is exemplified by the paper sheet S such as thick paper, postcard, thin paper, etc. However, the present teaching is not limited to this, and the sheet may be, for example, OHP sheet.

What is claimed is:

1. An image forming apparatus configured to form an image on a sheet-shaped medium, comprising:

a photosensitive body configured to receive formation of an electrostatic latent image thereon;

a developing cartridge arranged below the photosensitive body and having a developing roller configured to supply a developing agent to the photosensitive body and to be rotatable about a rotation shaft of the developing roller, the developing cartridge having a guided portion;

an apparatus body;

a support body configured to removably support the developing cartridge and to move between an extracted position at which the support body is extracted from the apparatus body and an accommodated position at which the support body is accommodated in the apparatus body, the support body being configured to accommodate the developing cartridge; and

a biasing member configured to bias the rotation shaft of the developing roller so as to bias the developing roller toward the photosensitive body, the biasing member having a guiding portion configured to guide the guided portion of the developing cartridge in a guiding direction;

wherein the guided portion of the developing cartridge is separate from the rotation shaft of the developing roller, and

wherein the biasing member is located in the support body, and is configured to bias the developing cartridge so that the developing cartridge is moved relative to the support body.

2. The image forming apparatus according to claim **1**, wherein:

the rotation shaft of the developing roller has an axis portion, the axis portion being coaxial with the rotation shaft and projecting in an extending direction of the rotation shaft, and

the biasing member is configured to bias the axis portion.

3. The image forming apparatus according to claim **1**, wherein:

the guiding portion is configured to guide the developing cartridge to an install position,

the guiding portion is supported by the support body to be movable in a facing direction in which the photosensitive body and the developing roller face each other, the guiding portion having an axial support portion configured to support the rotation shaft of the developing roller, and

the biasing member is configured to bias the guiding portion toward the photosensitive body.

4. The image forming apparatus according to claim **3**, wherein:

the developing cartridge has a cartridge-side electrode, and

the guiding portion has a support body-side electrode configured to contact the cartridge-side electrode.

5. The image forming apparatus according to claim **3**, wherein:

the guiding portion is formed to have a substantially U-shape, and includes a pair of guide portions extending substantially parallel to each other at a spacing distance, and a connection portion connecting the pair of guide portions,

the axial support portion is formed at end portions, of the guide portions, on a side opposite to the connection portion,

the developing cartridge has a substantially semi-cylindrical shaped boss projecting in an extending direction of the rotation shaft of the developing roller, and

the boss of the developing cartridge is disposed between the pair of guide portions of the guiding portion so that the developing cartridge is guided by the guiding portion.

6. The image forming apparatus according to claim **1**, wherein:

the guiding portion is configured to guide the developing cartridge to an install position, and

the support body includes a contact member configured to be movable with respect to the guiding portion in a facing direction in which the photosensitive body and the developing roller face each other, the contact member configured to contact with the rotation shaft, and

the biasing member is configured to bias the contact member toward the photosensitive body.

7. The image forming apparatus according to claim **1**, further comprising an apparatus body in which a fixing device configured to thermally fix an image of the developing agent on the medium is located,

wherein:

the photosensitive body and the developing cartridge include a plurality of photosensitive bodies and a plurality of developing cartridges, respectively,

the support body is configured to be pulled out from the apparatus body in a pull-out direction, and

the developing cartridge is removable with respect to the support body so that a removing direction in which the developing cartridges are removed from the support body extends in an inclined direction extending obliquely upwardly and toward downstream of the pull-out direction.

8. The image forming apparatus according to claim **7**, wherein the support body has a photosensitive body-support member being pivotably provided on the support body and configured to support the plurality of photosensitive bodies.

9. The image forming apparatus according to claim **8**, wherein the photosensitive body-support member is configured to be pivotable between a first posture in which each of the photosensitive bodies is brought into contact with the developing roller and a second posture in which each of the photosensitive bodies is refracted from the developing roller; and

a rotation angle defined by the first and second postures of the photosensitive body-support member is set to be greater than an angle defined by the removing direction with respect to the photosensitive body-support member under a condition that the photosensitive body-support member assumes the first posture.

10. The image forming apparatus according to claim **1**, further comprising a separating mechanism configured to separate the developing roller away from the photosensitive body,

wherein the separating mechanism separates the biasing member away from the photosensitive body so as to

separate the developing roller away from the photosensitive body while utilizing a self weight of the developing cartridge.

11. The image forming apparatus according to claim **1**, wherein the guiding portion of the biasing member includes a positioning portion located at an end of the guiding portion and configured to position the shaft of the developing roller, and

the guiding direction is inclined with respect to a horizontal direction.

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UNITED STATES PATENT AND TRADEMARK OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 9,323,174 B2
APPLICATION NO. : 13/600721
DATED : April 26, 2016
INVENTOR(S) : Shuichi Kato

It is certified that error appears in the above-identified patent and that said Letters Patent is hereby corrected as shown below:

In the Claims

In Column 10, Claim 9, Line 54:
Please delete “is refracted from” and insert --is retracted from--

Signed and Sealed this
Nineteenth Day of September, 2017

Joseph Matal

Joseph Matal
Performing the Functions and Duties of the
Under Secretary of Commerce for Intellectual Property and
Director of the United States Patent and Trademark Office